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A redefinition of *Umbrageocoris* with new species and new combinations (Heteroptera, Lygaeoidea, Geocoridae)

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Abstract

The geocorine (Hemiptera: Heteroptera: Lygaeoidea: Geocoridae) true bug genus *Umbrageocoris* Kóbor, 2019 is redefined based on new morphological information from newly acquired specimens. Two new species are described: *U. boonei* **sp. nov.** from continental Indomalaya and *U. malipatili* **sp. nov.** from Australia; two new combinations are proposed: *U. elegantulus* (Distant, 1904), **comb. nov.**, and *U. woodwardi* (Malipatil, 1994), **comb. nov.** (both transferred from *Geocoris* Fallén, 1814). Keys, diagnoses, and distribution data to the discussed species are provided. Hypotheses on the origin of *Umbrageocoris* and its relationship to other geocorine genera in the region are formulated. New country records: *U. elegantulus* (Papua New Guinea), *U. maai maai* (Thailand, Laos) and *U. woodwardi* (Papua New Guinea).

Key Words

big-eyed bugs, Geocorinae, Hemiptera, key, new placement, species description

Introduction

Geocoridae, commonly known as big-eyed bugs, are a moderately species-rich lygaeoid family exhibiting highly specialized morphology, yet their taxonomy and systematics are poorly understood (Readio and Sweet 1982; Malipatil 1994). Several species are of considerable agricultural importance as predators of various arthropod pests (Sweet 2000; Cassis and Gross 2002; Kóbor 2020). Representatives of the family are distributed in all terrestrial biomes of warm to moderate climate, including extreme habitats, e.g., deserts and high mountains. The largest and most diverse of the currently recognized five subfamilies is the nominotypical Geocorinae, with more than 220 described species in 18 valid genera (Dellapé and Henry 2022).

The recently described *Umbrageocoris* Kóbor, 2019 currently comprises two species, one of them with two subspecies (Kóbor 2019a, b). Representatives of the genus are known to be distributed from New Guinea and New Britain to Borneo and the Malay Peninsula (Kóbor 2019b). The study of materials deposited in collections in Europe and the US has resulted in new knowledge regarding the taxonomy and biogeography of the genus, and is presented in this study.

Methods

Specimens were borrowed from Bernice P. Bishop Museum, Honolulu, USA (BPBM), Muséum National d'Historie Naturelle, Paris, France (MNHN), Natural History Museum, London, United Kingdom (BMNH), and the Snow Entomological Collections, University of Kansas, Lawrence, USA (SEMC); a paratype of *U. boonei* sp. nov. is deposited in the personal collection of the author (PCPK). Additional comparative material for representatives of the genera *Geocoris* Fallén, 1814, *Stylogeocoris* Mondandon, 1913 and *Germalus* Stål, 1862 were borrowed from the collection of Hungarian Natural History Museum (HNHM) and BMNH.

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Label data are cited verbatim. Lines on labels are separated with '/'; contents of different labels are separated with '//'; remarks are given in square brackets '[ ]'.

Exoskeletal and genital structures were studied with Kern Optics OZL 466 stereoscopic and Keyence VHX 5000 digital microscopes. Photomicrographs were done with Keyence VHX 5000 digital microscope, and Kern Optics OZL 466 stereoscopic microscope mounted with Kern Optics OCD 832 (5 MPix) microscope camera. Morphological terminology was adapted from Malipatil and Blackett (2013) (general morphology), Kment and Vilímová (2010) (metathoracic scent efferent apparatus), Slater (1977) (mesothoracic wing), Slater and Hurlbutt (1957) (metathoracic wing), and Gao et al. (2017) (abdominal trichobothria). Genitalia were dissected and macerated as described in Kóbor (2019a). Measurements were performed on scaled images with the use of ImageJ v. 1.52 software; values are given in millimetres.

Distribution data were recorded in Microsoft Excel program in comma-delimited text format (.csv) and processed with QGIS 3.16 "Hannover software". WorldClim altitude raster layer (Fick and Hijmans 2017) and WWF terrestrial ecoregions shape files (Olson et al. 2001) were used to visualise and interpret distribution data.

Results

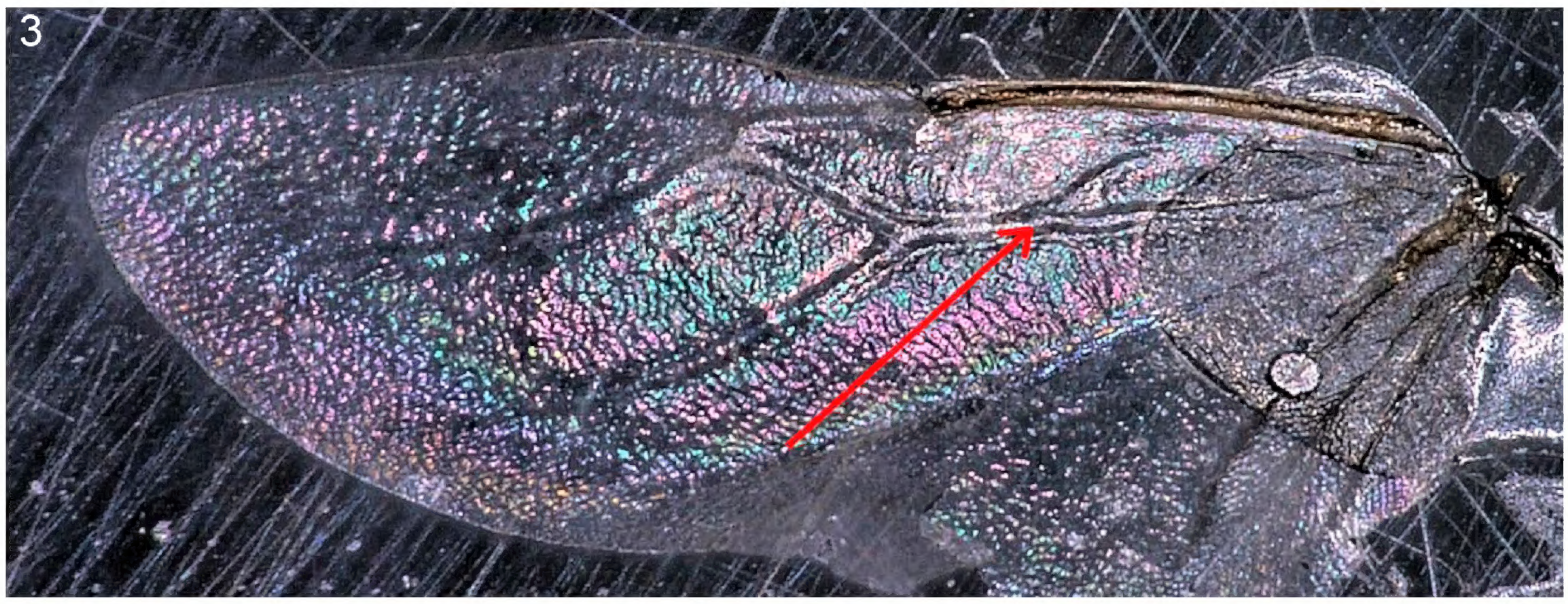
Taxonomy

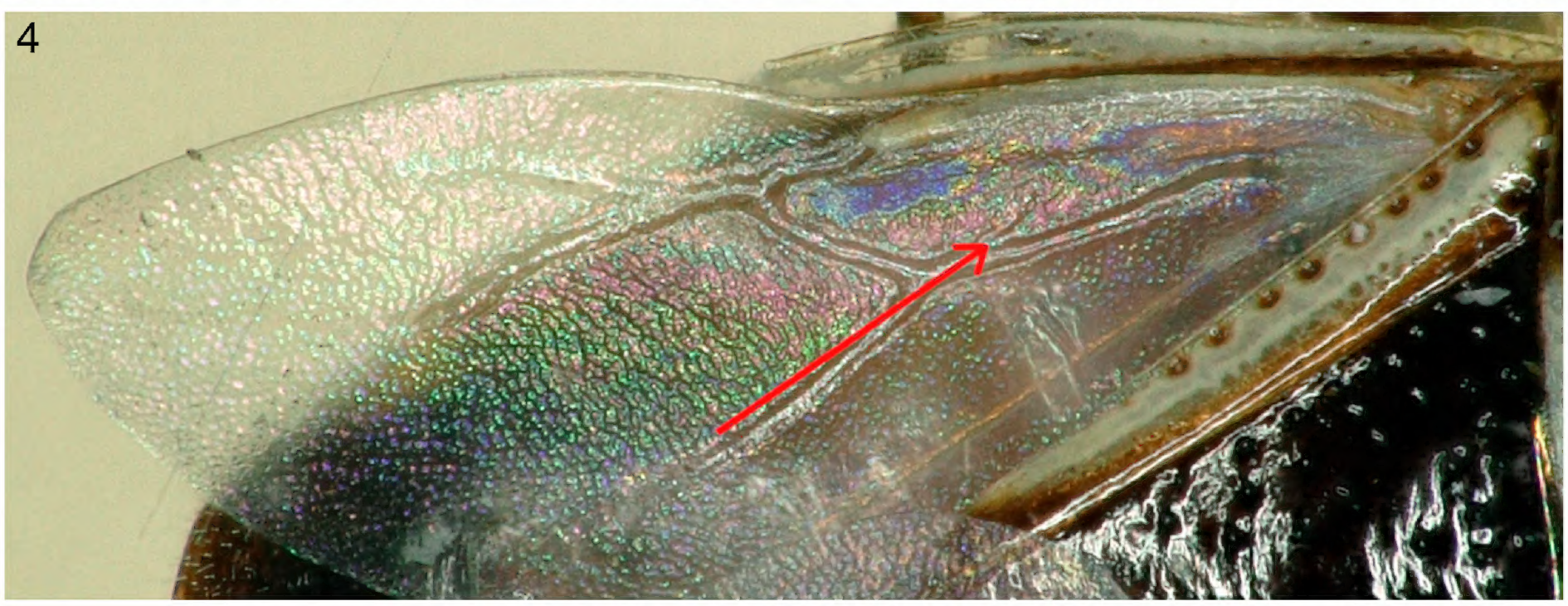
Genus *Umbrageocoris* Kóbor, 2019

Type species. *Umbrageocoris kondorosyi* Kóbor, 2019, by monotypy.

Redescription. General habitus ovoid, moderately elongate. Integument shiny, with sparse, silvery pubescence at least on abdominal venter. Head pentagonal; compound eyes large, reniform, slightly stylate; posterior edge of compound eyes touching anterior edge of pronotum. Ocular sulcus complete but shallow, slightly visible. Integument of vertex impunctate, with a thin longitudinal furrow of various length, at least present on clypeus. Antenniferous tubercles minute, not visible in dorsal view. Antennomere I shortest, graniform; antennomere II longest, cylindrical; antennomeres III and IV subequal in length; antennomere III cylindrical, antennomere IV fusiform. Clypeus with margins subparallel and apex rounded, surpassing the mandibular plates. Bucculae pointed, surpassing mandibular plates; ventral margins converging, forming a Y- or cup-shaped labial trough which continues in a suture of variable length towards base of head (Figs 1, 2). Labiomeres I–II conspicuously stouter than labiomeres III–IV; labiomere I not reaching anterior margin of propleurite, labiomere II shorter than labiomere III, apex of labiomere IV reaching or slightly surpassing metacoxae. Thorax. Pronotum trapeziform with anterior edges and margin broadly convex, lateral margin slightly constricted. Integument shiny, deeply punctate; punctation variably dense. Pronotal callosities and humeral angles at most moderately bulging. Scutellum elongate triangular, basal width less than length; variably punctate except at trifurcate carina. Trifurcate carina of scutellum complete or apically reduced. Apex of scutellum sharply pointed. Submacropterous, brachypterous and coleopterous wing morphs known. Submacropterous morph: hemelytron with margins of clavus converging apically, claval commissure reduced, indistinct; corium with lines of punctures along claval margin, Cu, and costal margin; punctation variably present between M-R and costal margin in the apical half of corium. M-R of corium branching in apical third. Exocorium mostly narrow, sometimes slightly flared in apical half. Membrane at most slightly surpassing apex of abdomen. Metathoracic wing with hamus partly reduced, level of reduction variable (Figs 3, 4); intervannals present, basally fused. Thoracic pleurites and sternites with dense punctation except prosternal collar, supracoxal lobes and peritreme of metathoracic scent efferent apparatus. Prosternite with a narrow, but conspicuously bulging collar. Peritreme bulbous with dorsal flange protruding, sometimes indented; vestibular scar present, reaching metasternal venter; evaporatorium reduced to extreme surroundings of peritreme (Figs 5–10). Femora of prothoracic legs more incrassate than those of meso- and metathoracic legs. Legs covered with sparse, decumbent pubescence; fore femora with simple trichobothria in a single line, fore tibia with strong, dense setosity ventrally. Tarsomeres I and III of pro- and mesothoracic legs subequal in length, tarsomere II shortest. Tarsomere III of metathoracic leg conspicuously elongate, longer than combined lengths of tarsomeres I and II. Abdomen. Abdominal tergites III–V rugose medially; sutures of tergites 4/5 and 5/6 strongly curved medially; suture 4/5 elongate nearly reaching suture 5/6 (Fig. 15). Abdominal sternites with rugose spots subdorsally. Abdominal trichobothria on sterintes III–IV with simple bothrium bearing a single sensilla, situated submedially, very close to each other in triangular arrangement (Fig. 11); trichobothria on sternites V–VII are subdorsal, either simple bothrium or trichome with microtrichia bearing a single sensilla, arrangement as in Fig. 3B. Genitalia. Posterior opening of male pygophore with pointed, short lateral processes, situated dorsolaterally; paramere with trunk moderately stout and blade slender, evenly curved (Fig. 13); gonoporal process of aedeagus with 10 coils. Female ovipositor short, bisecting only abdominal sternite VII (Fig. 14).

Comparative notes. *Umbrageocoris* displays a remarkable similarity to the Australian genus *Stylogeocoris* in general facies [studied species: *S. biroi* Montandon, 1913 (lectotype, HNHM) and *S. elongatus* (Distant, 1901) (lectotype and paralectotype, BMNH; non-types, PCPK). However, *Umbrageocoris* can be readily distinguished from the latter genus based on the combination of the following characters: integument of vertex





Figures 1–4. Exoskeletal characters of *Umbrageocoris*: **1–2.** Labial trough (indicated by arrow) of *U. kondorosyi* (**1**) and *U. malipatili* sp. nov. (**2**), **3–4.** Metathoracic wing (arrow indicates hamus) of *U. kondorosyi* (**3**) and *U. elegantulus* (**4**) (images not to scale).

smooth, dorsum of head with a single longitudinal furrow of various extent medially (it might be finely punctate and dorsum of head with arcuate grooves anteriad to ocelli in *Stylogeocoris*); labial through Y- or cup-shaped (V-shaped in *Stylogeocoris*); labiomere III longer than II (labiomeres II and III subequal in length in *Stylogeocoris*); margins of clavus converging gradually towards apex, claval commissure absent (margins of clavus subparallel, claval commissure short but distinct in *Stylogeocoris*); hamus of hemelytron partly reduced (complete in *Stylogeocoris*); peritreme rounded, evaporatorium reduced to surroundings of peritreme (peritreme auricular, evaporatorium covering most of the metapleurite in *Stylogeocoris*); sutures of abdominal tergites 4/5 elongate almost reaching margin of 5/6, apex of suture 5/6 obtuse (sutures of abdominal tergites 4/5 and 5/6 not elongate, apex rounded as in Fig. 15).

Umbrageocoris can be distinguished from representatives of genus *Geocoris* distributed in the region [studied species: *G. ochropterus* (Fieber, 1844) (lectotype, BMNH); *G. willeyi* Kirkaldy, 1905 (syntype, BMNH)] by the combination of following characters: head pentagonal, posterior edge of compound eyes touching anterior edges of pronotum (head lunulate, posterior edge of compound eyes encompassing anterior edges of pronotum in *Geocoris*); pronotum trapeziform with lateral margins slightly constricted medially (semicircular, lateral margins mostly not constricted in *Geocoris*); trifurcate carina of scutellum distinct, at most apically reduced (slightly distinct to completely reduced in *Geocoris*); hamus of metathoracic wing at most partly reduced, intervannals present, fused basally (hamus completely reduced and intervannals absent in *Geocoris*); apex of suture of abdominal tergites 5/6 obtuse (rounded in *Geocoris* sp., as in Fig. 18).

Umbrageocoris differs from representatives of *Germalus* [studied species: *G. coloratus* Distant, 1918 (syntype, BMNH); *G. fuscovittatus* Malipatil, 2013 (non-type, BMNH); *G. victoriae* Bergroth, 1895 (lectotype, BMNH)] by the following characters: ocular sulcus complete, but slightly visible (always well-defined in *Germalus*); labial through Y- or cup-shaped (U- or V-shaped in *Germalus*); labiomere III longer than II (labiomeres II and III subequal in length in *Germalus*); margins of clavus converging gradually towards apex, claval commissure absent (margins of clavus subparallel, claval commissure well-developed, distinct in *Germalus*); hamus of hemelytron partly reduced (complete in *Germalus*); peritreme rounded, evaporatorium reduced to surroundings of peritreme (peritreme auricular with dorsal supportive process, evaporatorium covering metapleurite and posterior half of mesopleurite in *Germalus*); sutures of abdominal tergites 4/5 and 5/6 elongated, suture 4/5 almost reaching margin of 5/6 (sutures of abdominal tergites 4/5 and 5/6 very short, strongly obtuse, as in Fig. 17).

Distribution. Representatives of the genus are distributed in continental Indomalaya and in the Indo-Australian Archipelago, from Laos to Northeast Australia (Northern Territories, Queensland, New South Wales).

Key to the species of *Umbrageocoris*

1 Labial trough cup-shaped with suture short, at most reaching middle of venter of head (Fig. 2); hamus of metathoracic wing partly reduced (Fig. 4) 2
– Labial trough Y-shaped with suture surpassing middle of venter of head (Fig. 1); hamus of metathoracic wing almost complete (Fig. 3) 4
2 Pronotum with an irregular fuscous marking only at callosities; median furrow of vertex short, not exceeding base of clypeus ..... *U. malipatili* sp. nov.
– Pronotum with extended dark brownish to blackish markings, anterior and posterior margins with pale ochraceous transversal bands; longitudinal median furrow extending from apex of clypeus to approximately middle of vertex 3
3 Vertex mostly blackish; transversal band at posterior margin of pronotum only present medially, not reaching humeral angles; dorsal flange of peritreme indented ..... *U. elegantulus* (Distant, 1918), comb. nov.
– Vertex at most basally blackish; transversal band at posterior margin reaching humeral angles; dorsal flange of peritreme not indented ..... *U. woodwardi* (Malipatil, 1994), comb. nov.
4 Humeral angles with fuscous spots; pronotum with coarse, relatively sparse punctation, anterior and posterior margin widely impunctate (*U. maai* ssp.) 5
– Humeral angles undecorated or if pronotum of dark ground colour then with ochraceous marking; pronotum with relatively dense punctation; anterior and posterior margin narrowly impunctate 6
5 Pronotum anteriad to callosities with a single row of punctures, surrounding callosities; punctures posteriad to callosities forming transversal bands ..... *U. maai timorensis* Kóbor, 2019
– Pronotum anteriad to callosities with more than one row punctures; pronotum posteriad to callosities evenly punctate ..... *U. maai maai* Kóbor, 2019
6 Vertex and margins of pronotum dark ochraceous; pronotal callosities separated by multiple punctures ..... *U. boonei* sp. nov.
– Vertex entirely dark brownish or blackish, pronotum blackish with small, ochraceous spot at each humeral angle; pronotal callosities confluent ..... *U. kondorosyi* Kóbor, 2019

Umbrageocoris kondorosyi Kóbor, 2019

Figs 1, 3, 5, 15

Diagnosis. *U. kondorosyi* can be distinguished from other species of the genus by the entirely blackish pronotum decorated with small ochraceous spots at humeral angles; irregular brownish spots covering most of the corium; confluent pronotal callosities; and a narrow impunctate band at the posterior edge of pronotum, widened at humeral angles.

Distribution. Distributed across New Guinea and adjacent islands. The species inhabits mostly rainforests, but records from mangroves and grasslands are available too.

Umbrageocoris maai maai Kóbor, 2019

Figs 6, 20, 27

Material examined. 2 m, 2 f (BPBM): „Thailand: Mae Klang / Chiang Mai Prov. / 340 m, 11. VI. 1965 // K. Morimoto / Collector // U. S.-Japan / Coop. Sci. / Program"; 1 f (BPBM): "Thailand / Nakhon Nayok Prov. / Khao Yai Nat. Park / 6. VI. 1965 // K. Morimoto / Collector // U. S.-Japan / Coop. Sci. / Program"; 1 m (BPBM): "Laos: / Vientiane Prov. / Ban Van Eue / 20. IX. 1967 // Native Collector / RONDON - - BISHOP MUS. / COLLECTION".

Diagnosis. *U. maai maai* is similar to *U. boonei* sp. nov. in general aspect, but the following remarkable differences enable its reliable separation from the latter species: vertex with blackish marking (lacking in *U. boonei*); decoration of pronotum distinctly delimited, with brownish spots at humeral angles (indistinctly delimited, somewhat blurred, spots at humeral angles lacking in *U. boonei*, compare Figs 8A, 10A); punctation of pronotum sparse and coarse, pronotum with impunctate "collar" anteriad to callosities (with fine, dense punctation and without significant impunctate areas in *U. boonei*).

Distribution. The species is distributed from Thailand to Borneo and Java and has data from the following ecoregions: Northern Khorat Plateau moist deciduous forests, Southeast Indochina dry evergreen forests, Peninsular Malaysian rainforests, Kinabalu montane alpine meadows, Borneo lowland rainforests, Sundaland heath forests, and Eastern Java-Bali rainforests.

Umbrageocoris maai timorensis Kóbor, 2019

Figs 21, 27

Diagnosis. The subspecies differs from the nominotypical *U. maai maai* in having less extended pronotal markings and larger impunctate areas on pronotum (a single transversal line of punctures anteriad to callosities, 3–4 transversal rows posteriad to them).

Distribution. The species is known from Ermera, Timor (Timor and Wetar deciduous forest ecoregion).

Umbrageocoris boonei sp. nov.

https://zoobank.org/3621BA1D-DD39-4407-8BBA-E8628ED46DC5

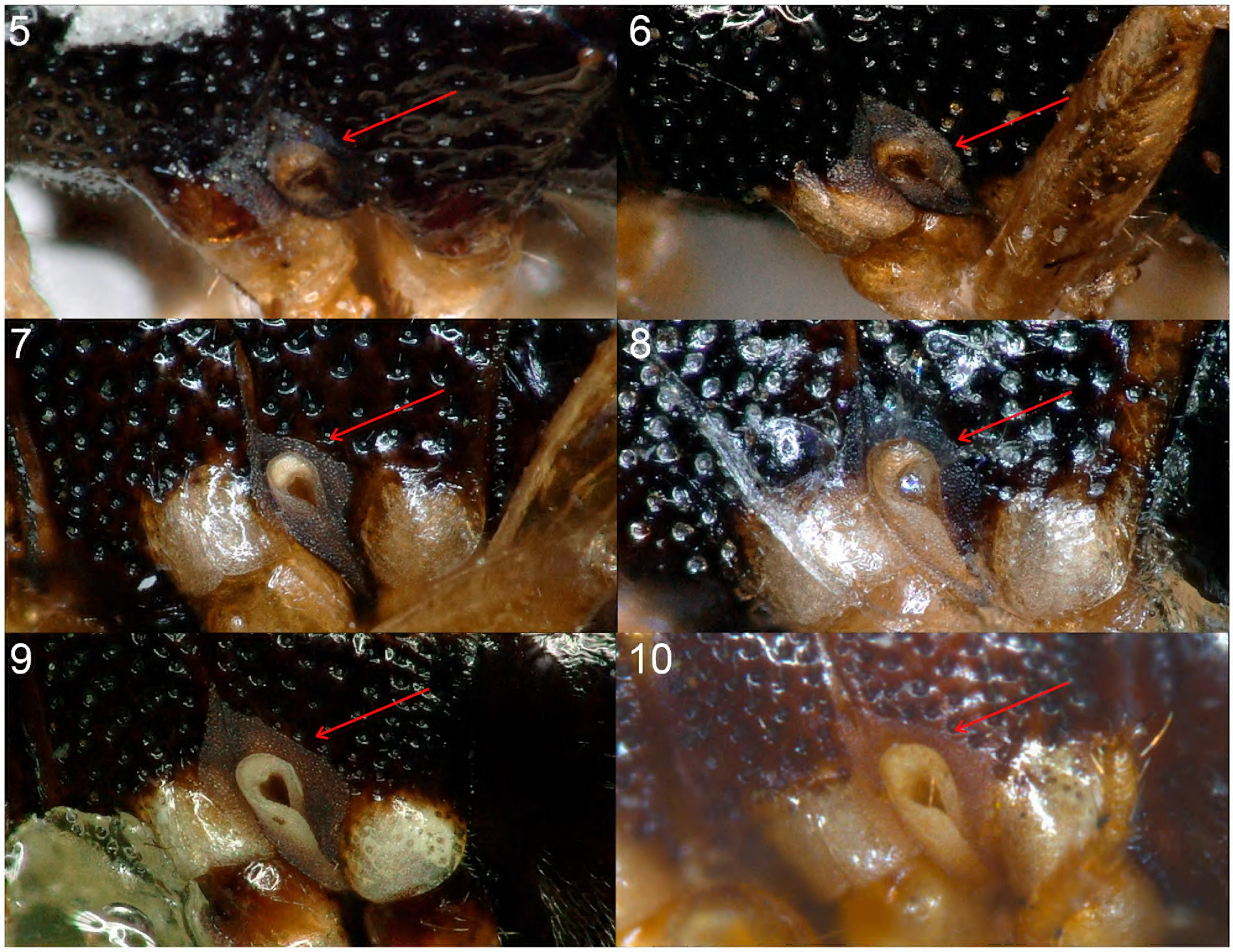
Figs 7, 22, 27

Material examined. ***Holotype***, m (BPBM): "Thailand / Chiangmai Prov.: / Chiangmai / (Arboretum), 300m / 12. VI. 1965 // P. D. Ashlock / Collector / BISHOP Mus. // U. S.-Japan / Coop. Sci. / Program".

***Paratypes*:** 2 m (BPBM): "Laos: Sedone Prov. / Paksong, 18. V. 1965 // P. D. Ashlock / Collector / BISHOP MUS."; 1 m (BPBM): "Laos: Ban Theoung / 18km NW from Xieng / Khouang, 1035 m / 2–6. VIII. 1960 // Sweeping grasses // R. F. Leech / Collector / BISHOP"; 1 m (BPBM) "Thailand / Chiangmai Prov.: / Doi Suthep / / 12. VI. 1965 // P. D. Ashlock / Collector / BISHOP Mus. // U. S.-Japan / Coop. Sci. / Program"; 1 m (BPBM): "Thailand: Tang Kao / Chiang Mai Prov. / 10. VI. 1965 // P. D. Ashlock / Collector / BISHOP Mus. // U. S.-Japan / Coop. Sci. / Program"; 1 f (BPBM): Thailand / Bangkok / June 3, 1965 // P. D. Ashlock / Collector / BISHOP Mus."; 1 m (PCPK): "LAOS: Sedone Prov. / Paksong, 18. V. 1965 // P. D. Ashlock / Collector / BISHOP MUS.".

Description. ***Colouration*:** Head ochraceous with dark brownish irregular spot at base of eye stalks posteriorly. Antennomere I ochraceous with apex irregularly brownish; antennomeres II and III entirely dark brownish; antennomere IV dark brownish with apex ochraceous. Labiomeres uniformly ochraceous. Thorax. Pronotum ochraceous with dark brownish punctation, a dark brownish or dark fuscous transversal band across callosities and irregular infuscate spot of various extent posteriad to callosities. Scutellum entirely dark brownish or blackish. Hemelytra semi-hyaline, ochraceous with dark brownish punctation and an irregular infuscate spot at apical half of corium. Thoracic pleurites and sternites dark brownish except ochraceous prosternal collar, supracoxal lobes and peritreme. Abdomen dark brownish, undecorated.

***Structure*:** Head. Eyes slightly stylate; ocular sulcus complete, but slightly visible, rather indistinct in apical half. Ocelli situated near ocular sulci, closer to each other than to compound eyes; ratio of ocellar distance to eye ocellus distance: 1: 1.16. Dorsum of head with median longitudinal furrow extending from apex of clypeus to base of head. Relative lengths of antennomeres: 1.00: 2.40: 1.82: 4.36. Relative lengths of labiomeres: 1.00: 0.57: 0.81: 0.98. Thorax. Pronotum trapeziform with lateral margin not constricted; integument densely and deeply punctate at anterior margin and narrow pronotal callosities; pronotum length to basal width: 1.00: 1.35. Scutellum with integument densely punctate except slightly bulging, complete trifurcate carina; scutellum length to width: 1.00: 1.07. Corium submacropterous, membrane slightly surpassing apex of abdomen; corium punctate along margin of clavus, along Cu and between M-R and costa at apical half; exocorium uniformly narrow at entire length; membrane wrinkled. Thoracic sternites and pleurites densely punctate except narrow prosternal collar,



Figures 5–10. Exoskeletal characters of *Umbrageocoris*: peritreme of metathoracic scent efferent apparatus of *U. kondorosyi* (**5**), *U. maai maai* (**6**), *U. boonei* sp. nov. (**7**), *U. malipatili* sp. nov. (**8**), *U. elegantulus* (**9**), and *U. woodwardi* (**10**) (images not to scale).

supracoxal lobes and peritreme. Peritreme bulbous, situated ventrolaterally; dorsal flange with distinct peritremal surface; evaporatorium restricted to surroundings of peritreme. Abdomen. Abdominal venter with sparse, decumbent pubescence; integument of abdominal sternites III-VII corrugate dorsolaterally.

Measurements (holotype). Body length: 3.11; head length: 0.62; head width: 1.51; lengths of antennomeres I–IV: 0.14–0.33–0.25–0.60; lengths of labiomeres I–IV: 0.47–0.27–0.38–0.46; pronotum length: 0.83; pronotum width: 1.39; scutellum length: 0.72; scutellum width: 0.79.

Diagnosis. *U. boonei* gen. nov. resembles both subspecies of *U. maai* in colouration and markings. The new species can be distinguished from other representatives of the genus by lacking an impunctate "collar" on the pronotum and its highly extended trifurcate carina on the scutellum.

Distribution. The species is known from continental Indomalaya (Laos and Thailand) from the following ecoregions: Kayah-Karen montane rainforests, Luang Prabang montane rainforests, Southern Annamites montane rainforests, Chao Praya freshwater swamp forests, Indochina mangroves.

Umbrageocoris malipatili sp. nov.

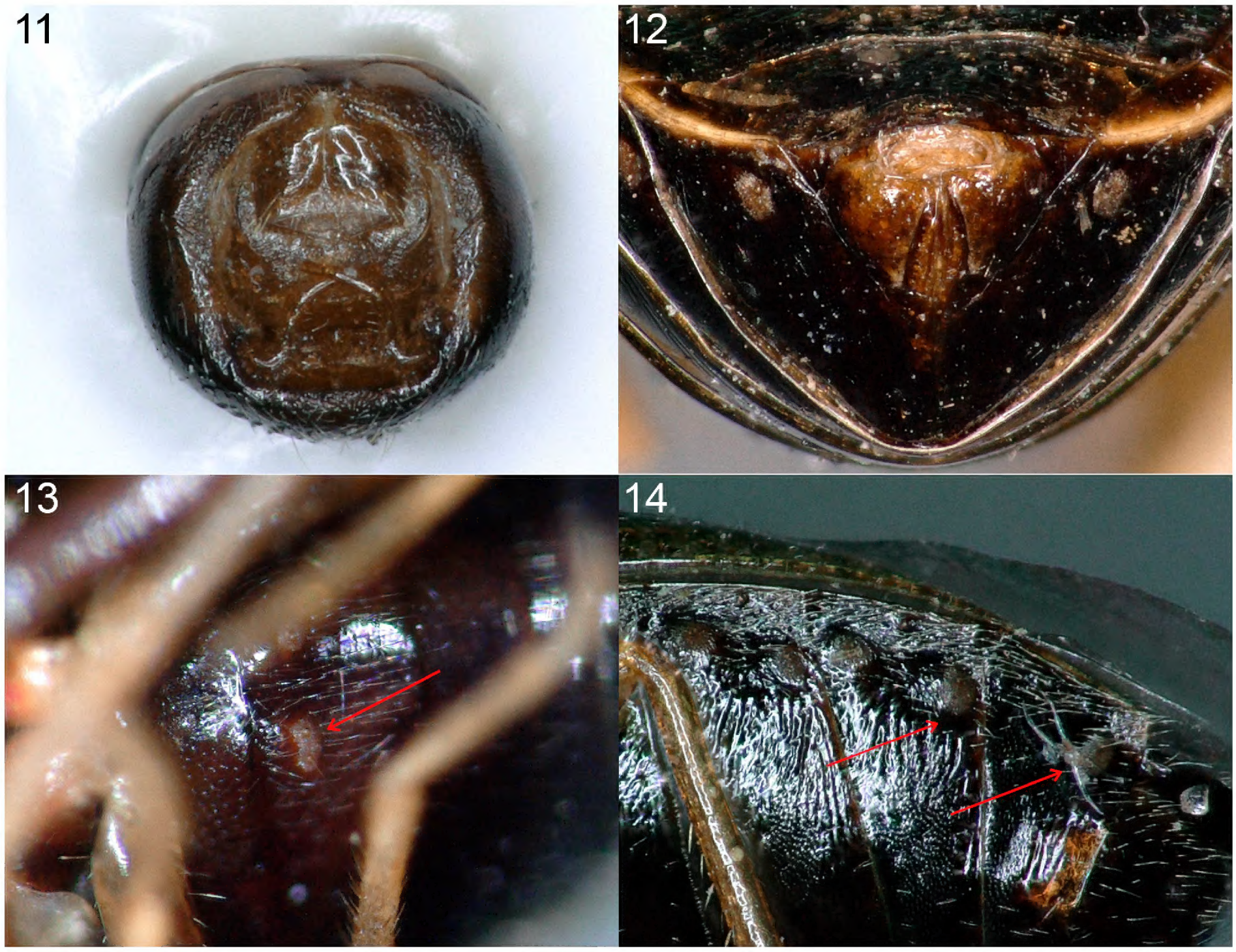
https://zoobank.org/A5568832-84E7-4502-8741-97398F57F841

Figs 2, 7, 23, 28

Material examined. ***Holotype***, f (MNHN): "MUSEUM PARIS / NOUV. GALLES DU SUD / COLL. NOUALHIER 1898".

Description. ***Colouration*****:** Head ochraceous, posterior part of eye stalks with irregular brownish marking. Eyes reddish, ocelli hyaline. Antennae missing in the single examined specimen. Labiomeres dark ochraceous. Thorax. Pronotum ochraceous with brownish punctation and an infuscate transversal band across pronotal callosities. Scutellum entirely dark brownish. Hemelytra semi-hyaline, ochraceous with brownish punctation and an irregular infuscate spot on the corium. Thoracic pleurites and sternites dark brownish except prosternal collar, supracoxal lobes and peritreme; propleurite with an ochraceous spot dorsally. Abdomen dark brownish both dorsally and ventrally with a whitish longitudinal band at dorsal part of sternites.

Structure**:** Head. Median furrow of vertex short, hardly surpassing base of clypeus. Antennomeres missing. Labial trough Y-shaped with suture reduced,



Figures 11–14. Exoskeletal characters of *Umbrageocoris*: male pygophore with parameres *in situ* (**11**), female ovipositor *in situ* (**12**), arrangement of abdominal trichobothria on sternite IV (**13**) and sternites V–VII (**14**)

reaching approximately midline of head. Relative lengths of labiomeres: 1.00: 0.85: 1.32: 1:38. Thorax. Pronotum with dense and deep punctation except anterior margin, pronotal callosities and posterior margin with humeral angles. Pronotal callosities confluent. Pronotum length to basal width: 1.00: 1.76. Scutellum with trifurcate carina apically reduced. Hemelytra submacropterous. Scutellum length to basal width: 1.00: 1.06. Clavus with an incomplete row of punctures at corial margin. Corium punctate along margin of clavus, Cu, between M-R and costa in apical half. Exocorium slightly widened subapically. Membrane short, not surpassing apex of abdomen.

Measurements. Body length: 4.20; head length: 0.53; head width: 1.66; lengths of labiomeres I–IV: 0.36–0.30–0.47–0.49; pronotum length: 0.88; pronotum width: 1.54; scutellum length: 0.88; scutellum width: 0.83.

Diagnosis. *U. malipatili* sp. nov. resembles *U. boonei* sp. nov. and both subspecies of *U. maai* in colouration and markings, but its cup-shaped labial trough and the presence of a minute furrow on its clypeus readily distinguishes it from the Indomalayan representatives of the genus.

Distribution. The single known specimen is from an unknown locality in New South Wales, Australia.

Umbrageocoris elegantulus (Distant, 1904), comb. nov.

Figs 4, 9, 25, 26, 28

Type material examined. ***Lectotype***, m (BMNH): circular blue syntype label // circular red type label // "elegantulus / Dist. [hw2] // 1903 – 322. // UNSW_ENT 00011372 // BMNH(E) / 1231237 // NHMUK 010591767 // Townsville, Qld / 16.12.02 / F. P. Dodd."

Additional material examined. 1 m (SEMC): "NEW Guinea: Papua / Koitake / 2. X. 1958 / J. L. Gressitt / Collector".

Additions and corrections to the redescription of Malipatil (1994). Head. Median longitudinal furrow extends from middle of clypeus to middle of vertex. Labial trough cup-shaped with suture reaching only middle of venter of head. Thorax. Peritreme bulbous, dorsal flange indented.

Diagnosis. *U. elegantulus* resembles *U. woodwardi* in general appearance but can be distinguished from the latter species based on the following characters: vertex with extended blackish markings (vertex only marked basally in *U. woodwardi*); dorsal flange of peritreme indented (Fig. 9.) (not indented in *U. woodwardi*).

Distribution. The species was recorded from the northern parts of Australia in the following ecoregions: Arnhem

Figures 15–18. Sutures of abdominal tergites 4/5 and 5/6 in *Umbrageocoris kondorosyi* (**15**), *Stylogeocoris elongatus* (**16**), *Germalus victoriae* (**17**) and *Geocoris* (*Geocoris*) *willeyi* (**18**) (images not to scale).

land tropical savanna, Cape York Peninsula tropical savanna, Queensland tropical rainforests, Brigalow tropical savanna (Malipatil 1994). A specimen from Koitake, New Guinea (Southeastern Papuan rain forest ecoregion) was examined.

Remarks. This species was described as *Geocoris elegantulus* (Distant 1904) and cited as such by subsequent authors (Malipatil 1994; Cassis and Gross 2002). A careful examination of both type and non-type specimens available concluded that the species displays synapomorphies used to define *Umbrageocoris*, including the presence of a median groove on vertex, a Y- or cup-shaped labial trough, and the arrangement of sutures at abdominal tergites 4/5 and 5/6, thus the following new combination is here proposed: *Umbrageocoris elegantulus* (Distant, 1904), comb. nov.

Figures 19–24. Dorsal habitus of *Umbrageocoris* species: **19.** *U. kondorosyi* (holotype, HNHM), **20.** *U. maai maai* (holotype, BPBM), **21.** *U. maai timorensis* (holotype, BPBM), **22.** *U. boonei* sp. nov. (holotype, BPBM), **23.** *U. malipatili* sp. nov. (holotype, MNHN), **24.** *U. woodwardi* (SEMC) (scale bar = 1 mm for all images).

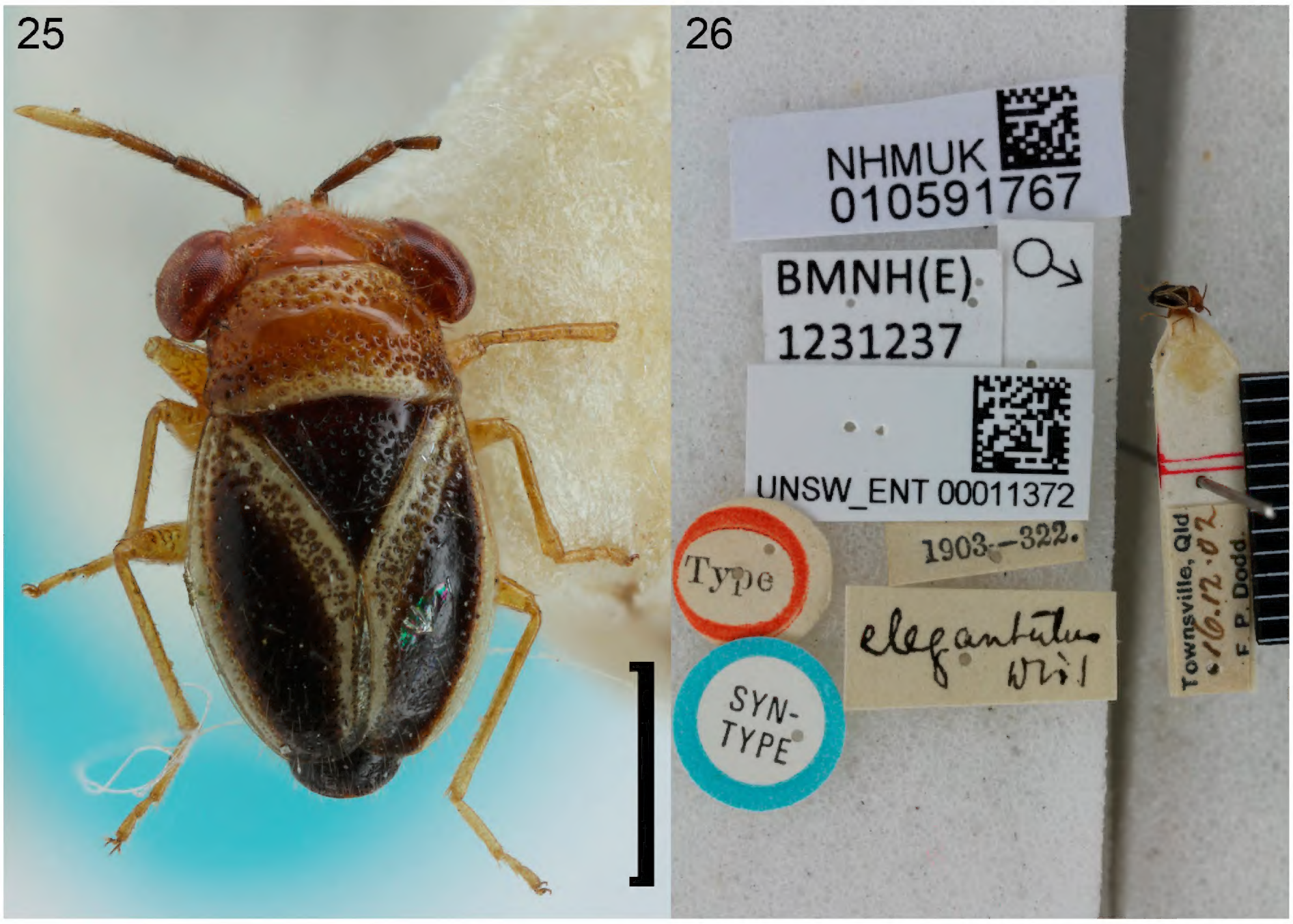
***Umbrageocoris woodwardi* (Malipatil, 1994), comb. nov.**

Figs 10, 24, 28

Material examined. 2 f (BPBM): „New Guinea: NE. / Moife 2100 m. / 7–14. X. 1959 // Swept in / clearing // T. C. Maa / Collector / BISHOP"; 1 f BPBM: „NE. / Moife 2100 m. / 15km NW of Okapu / 7–14. X. 1959 // T. C. Maa / Collector / BISHOP".

Additions and corrections to the description of Malipatil (1994). Head. Median longitudinal furrow of vertex minute, hardly surpassing base of clypeus. Labial trough cup-shaped with suture short, hardly reaching middle of venter of head. Thorax. Peritreme bulbous, dorsal flange not indented.

Diagnosis. *U. woodwardi* resembles *U. elengantulus* in general aspect, but it can be distinguished from the latter species based on the combination of the following characters: vertex with dark marking only basally (with more extensive dark markings in *U. elegantulus*); dorsal flange of peritreme simple (indented in *U. elegantulus*).



Figures 25–26. Lectotype of *Geocoris elegantulus* Distant, 1904 (BMNH): **25.** Dorsal habitus (scale bar = 1 mm), **26.** Labels (image not to scale).

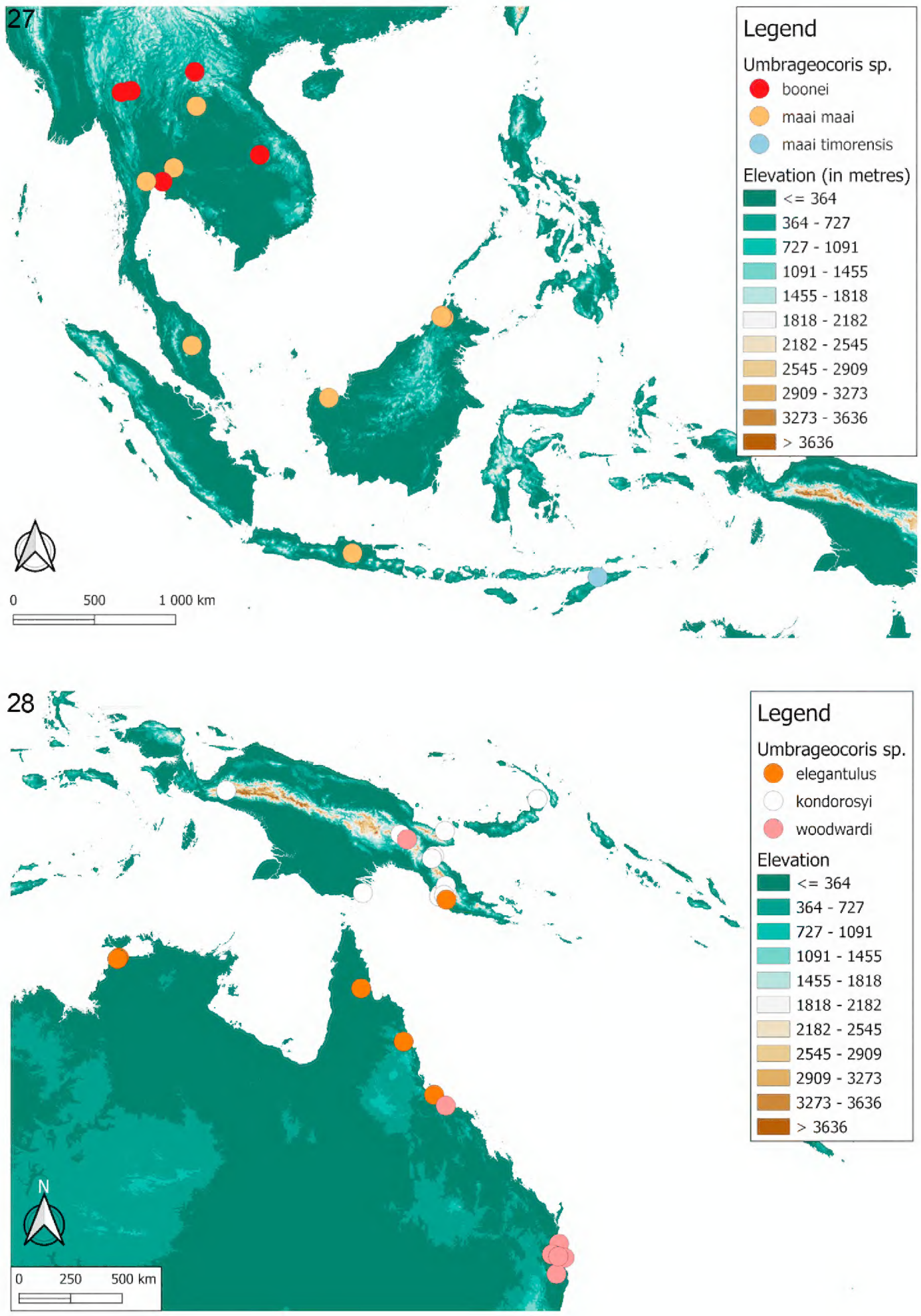
Distribution. Most of the published records of the species are from Western Australia, where the species inhabits Brigalow tropical savanna and Eastern Australian temperate forest habitats (Malipatil 1994). In the material deposited in the BPBM three specimens from the Central Range montane rain forests of New Guinea are present.

Remarks. Based on the specimens available as well as the original description and illustrations provided by Malipatil (1994) the species possesses a combination of characters diagnostic of *Umbrageocoris*, including the presence of a median longitudinal furrow on vertex, a cup- or Y-shaped labial trough, and the arrangement of sutures of abdominal tergites 4/5 and 5/6. The following new combination is accordingly proposed: *Umbrageocoris woodwardi* (Malipatil, 1994), comb. nov.

Discussion

Umbrageocoris displays character states shared with at least one of the other three geocorine genera present in the Indomalaya and the Indo-Australian Archipelago, viz., *Geocoris*, *Germalus* and *Stylogeocoris*, but also possesses a number of unique character states, most importantly the shape of the labial trough or the arrangement of suture of abdominal tergites 4/5 and 5/6. The genus was originally described as monotypic with the type species *U. kondorosyi* (Kóbor 2019a); later a second species with two subspecies, *U. maai maai* and *U. maai timorensis*, was added (Kóbor 2019b). An examination of additional materials resulted in the discovery of two undescribed species, *U. boonei* sp. nov. and *U. malipatili* sp. nov. A study of two Australian species formerly included in the species-rich and apparently not monophyletic genus *Geocoris*, *G. elengantulus* and *G. woodwardi*, resulted in the transfer of these species into *Umbrageocoris*.

Members of the genus *Umbrageocoris* apparently can be divided into an Australian and an extra-Australian lineage based on morphological differences. The Australian species (*U. elengantulus*, *U. malipatili* sp. nov. and *U. woodwardi*) share a shorter median longitudinal furrow on the head, reaching at most the middle of vertex (in non-Australian species this furrow always reaches the base of vertex); a cup-shaped labial trough (Y-shaped in non-Australian species); and a partly reduced hamus of the metathoracic wing (non-Australian species possess an almost complete hamus). Short-winged (brachypterous or coleopterous) and secondarily flightless species occur in all of the Australian species, whilst all known individuals of the non-Australian species are submacropterous. Based on morphological characters, the closest relative of *Umbrageocoris* appears to be *Stylogeocoris*, an endemic Australian genus, albeit the



Figures 27–28. Distribution map of *Umbrageocoris* species: **27.** Indomalayan species (*U. maai* ssp. and *U. boonei* sp. nov.), **28.** Australasian species (*U. elegantulus*, *U. kondorosyi*, *U. malipatili* sp. nov. and *U. woodwardi*).

relationship between the two genera should be examined in frames of a broader phylogenetic reconstruction. *Stylogeocoris* is suspected to be an old, isolated faunal element of Australian lygaeoids with an area shaped by the climatic oscillation in the Tertiary (Slater 1975). According to information available at present, the area of *Umbrageocoris* corresponds to that of *Stylogeocoris*. The presence of wing polymorphism and secondary flightlessness in Australian members of *Umbrageocoris* suggests that these species evolved for a long time in a relatively stable environment, as suggested by Slater (1977). Taking all of the above into account it is suspected that *Stylogeocoris* and *Umbrageocoris* are the members of the same very old fauna and they originate from a common ancestor. This hypothesis should be examined within a broader analysis of the phylogeny and phylogeography of the group.

Medially curved sutures of abdominal tergites 4/5 and 5/6 were proposed as a synapomorphy of the family Geocoridae (Henry 1997). However, the variability of this condition within the subfamilies and genera of the family has not been studied in detail. The present results suggest that this character displays generic level differences in the studied genera. A more extensive study of its taxonomic significance is therefore suggested and planned by the author.

Conclusions

The present work resulted in the redefinition of the genus *Umbrageocoris*, the description of two new species of the genus, and the revision of the generic placement of two species originally placed into the genus *Geocoris*. Based on the new morphological information a hypothesis regarding the origin of *Umbrageocoris* and its relationship to other geocorine taxa in the region was formulated. The comparative study of the sutures of abdominal tergites was proposed as a new exoskeletal character for defining genera in Geocoridae.

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References

Cassis G, Gross G (2002) Hemiptera: Heteroptera (Pentatomomorpha). In: Houston WWK, Wells A (Eds) Zoological Catalogue of Australia, Volume 27.3 B. CSIRO Publishing, Melbourne, 737 pp.

Dellapé PM, Henry TJ (2022) Lygaeoidea Species File. Version 5.0/5.0. [retrieval date: 30. 03. 2022] http://Lygaeoidea.SpeciesFile.org

Distant WL (1904) Rhynchotal Notes. XXII. Heteroptera from North Queensland. Annals & Magazine of Natural History 1, Series 7, 3(7): 263–276. https://doi.org/10.1080/00222930409487068

Fick SE, Hijmans RJ (2017) WorldClim 2: New 1-km spatial resolution climate surfaces for global land areas. International Journal of Climatology 37(12): 4302–4315. https://doi.org/10.1002/joc.5086

Gao QC, Rédei D, Shi X, Cai B, Liang K, Gao S, Bu W (2017) A comparative study of the abdominal trichobothria of Trichophora, with emphasis on Lygaeoidea (Hemiptera: Heteroptera). European Journal of Entomology 114: 587–602. https://doi.org/10.14411/eje.2017.072

Kment P, Vilímová J (2010) Thoracic scent efferent system of Pentatomoidea. Zootaxa 2706(1): 1–77. https://doi.org/10.11646/zootaxa.2706.1.1

Kóbor P (2019a) Umbrageocoris kondorosyi: a new genus and species of big-eyed bugs from New Guinea (Heteroptera: Lygaeoidea: Geocoridae). Acta Zoologica Academiae Scientiarum Hungaricae 65(1): 1–8. https://doi.org/10.17109/AZH.65.1.1.2019

Kóbor P (2019b) Contributions to the knowledge of Umbrageocoris (Heteroptera: Lygaeoidea: Geocoridae). Zootaxa 4652(2): 384–390. https://doi.org/10.11646/zootaxa.4652.2.11

Kóbor P (2020) A review on biology and agricultural significance of big-eyed bugs (Heteroptera: Lygaeoidea: Geocoridae). Hungarian Agricultural Research 29(2): 4–10.

Malipatil MB (1994) Revision of Australian Geocoris Fallen and Stylogeocoris Montandon (Heteroptera: Lygaeidae: Geocorinae). Invertebrate Systematics 8(2): 299–327. https://doi.org/10.1071/IT9940299

Malipatil MB, Blackett MJ (2013) Review and revision of Australian Germalus Stål, with new genera and further new species of Australian Geocorinae (Hemiptera: Heteroptera: Geocoridae). Zootaxa 3746(2): 257–300. https://doi.org/10.11646/zootaxa.3746.2.3

Olson DM, Dinerstein E, Wikramanayake ED, Burgess ND, Powell GVN, Underwood EC, D'Amico JA, Itoua I, Strand HE, Morrison JC, Loucks CJ, Allnutt TF, Ricketts TH, Kura Y, Lamoreux JF, Wettengel WW, Hedao P, Kassem KR (2001) Terrestrial ecoregions of the world: A new map of life on Earth. Bioscience 51(11): 933–938. https://doi.org/10.1641/0006-3568(2001)051[0933:TEOTWA]2.0.CO;2

Readio J, Sweet MH (1982) A review of the Geocorinae of the United States of the 100th Meridian (Hemiptera: Lygaeidae). Miscellaneous Publications of the Entomological Society of America 12: 1–91.

Slater JA (1975) On the biology and zoogeography of Australian Lygaeidae (Hemiptera: Heteroptera) with special reference to the southwest fauna. Australian Journal of Entomology 14(1): 47–64. https://doi.org/10.1111/j.1440-6055.1975.tb02002.x

Slater JA (1977) The incidence and evolutionary significance of wing polymorphism in lygaeid bugs with particular reference to those of South Africa. Biotropica (USA) 9(4): 217–229. https://doi.org/10.2307/2388139

Slater JA, Hurlbutt HW (1957) A comparative study of the metathoracic wing in the family Lygaeidae (Hemiptera: Heteroptera). Proceedings of the Entomological Society of Washington 59(2): 67–79.

Sweet MH (2000) Economic importance of predation by big-eyed bugs (Geocoridae). In: Schaefer CW, Panizzi AR (Eds) Heteroptera of economic importance. CRC Press, Boca Raton, 713–724. https://doi.org/10.1201/9781420041859.ch30